IMPROVEMENTS IN THE DEVICE AND METHOD FOR DISCHARGING DRY MATERIALS FROM STORAGE VESSELS

DESCRIPTION

[Para 1] BACKGROUND

[Para 2] 1. Field of Invention

[Para 3] This invention relates to improvements for discharging dry, powder-like materials from storage silos.

[Para 4] 2. Description of Related Art

[Para 5] As many bakeries and other processors of powder materials (such as flour, starch, talc and the like that can be fluidized for more efficient discharge) improve their operations, the need for an aeration discharge device that is virtually maintenance free, allows a quick change aeration liner method and that can empty the contents of a silo in excess of 99% is required.

[Para 6] One of the more vexing problems in providing a heavy-duty discharge aeration liner device is that the surface under the liner must allow the free flow a air through itself and still be able to maintain loads of as much as 1,200 per square foot. In addition, the aeration liner must be fabricated so that it does not leak and be fabricated in a cone-like shape in excess of 15 degrees. During the past thirty to forty years, as more and more industries require a discharge method, ensuring first-in, first-out discharge, complete clean out and a quick and easy method for replacing a used aeration liner, the need for this invention has grown.

[Para 7] SUMMARY

[Para 8] It is the object of the invention to provide a simple and heavy-duty method of fabrication of the device.

[Para 9] Another object of the invention is to reduce and eliminate infestation of materials, such as flour and other grain products, as they are stored in the bulk system.

[Para 10] Another object of the invention is to provide a quick, safe and easy method of replacing the aeration liner.

[Para 11] Yet another object of the invention is to provide a low-cost structural design and less expensive structural components of the discharge device.

[Para 12] Another object of the invention is to provide a sanitary, smooth and virtually seamless interior wall surface to reduce the chance of contamination, infestation and leaking.

[Para 13] It is another object of the invention to provide a simple and reliable device for distributing the air to each of the zones of the fluidized bed.

[Para 14] Another object of the invention is to provide it in a kit form for easy shipping and handling.

[Para 15] It is another object of the invention to provide the invention in a form and design that is quick and easy to erect and assemble.

[Para 16] Yet another object of the invention is to allow the user a quick and easy method for removing and replacing the fluidized bed.

[Para 17] Another object of the invention is to eliminate the use of fasteners for holding the aeration liner in place.

[Para 18] BRIEF DESCRIPTION OF DRAWINGS

[Para 19] FIG. 1 is a side view of the dished head component of the air disc.

[Para 20] FIG. 2 is a top view of the dished head component of the air disc.

[Para 21] FIG. 3 is a side view of the perforated hopper component of the air disc.

[Para 22] FIG. 4 is a top view of the perforated hopper component of the air disc.

[Para 23] FIG. 5 is side view of the air disc, showing the perforated hopper installed.

[Para 24] FIG. 6 is a top view of the air disc with the perforated hopper installed.

[Para 25] FIG. 7 is a side view of the aeration liner.

[Para 26] FIG. 8 is a detailed, top view of the aeration liner.

[Para 27] FIG. 9 is a side view of the air disc attached to but disengaged from the silo for the liner changing operation.

[Para 28] FIG. 10 is a side view of the aeration liner sections jointed together by a webbing strip.

[Para 29] FIG. 11 is a top view of the aeration liner sections joined together by a webbing strip.

[Para 30] FIG. 12 is a side view of a slip ring mounted on the spout of the air disc flange to connect with the flange of another discharge assembly.

[Para 31] DETAILED DESCRIPTION OF DRAWINGS

[Para 32] FIG. 1 is a side view of air disc 19. Fabrication of disc 19 begins by cutting access port openings 31 and 32, air stub opening 24a and outlet opening 25.

[Para 33] Bolt holes (not shown) are made in flange ring 21 and then welded to dished head 20. Air stub nozzle 24 is welded around air stub opening 24a to allow an air passageway inside dished head 20. Access port flanges 23a and 23b are welded to access port openings 31 and 32 respectively. Outlet collar 26 with outlet flange 27 is welded around outlet opening 25. Outlet flange ring 22 will be used to secure aeration liner (not shown) around outlet opening 25. Air disc 19 can be made with multiple openings 25, each opening having its own outlet collar 26 and outlet flange 27.

[Para 34] FIG. 2 is a top view of air disc 19. Flange bolts holes 33a - 33x are shown spaced equally apart on flange ring 21. Threaded boltholes 34a - 34d are also shown spaced equally apart around the perimeter area of flange ring

21. Outlet boltholes 29a - 29 k are made to register in holes (not shown) of outlet flange ring 22. Outlet flange 27 is shown under dished head 21 around outlet flange opening 30.

[Para 35] **FIG. 3** is a side view of perforated hopper 35. Hole(s) 36c are made around perforated hopper at a large radius, hole(s) 36b are made around perforated hopper at a medium sizes radius and holes(s) 36a make up the airways in perforated hopper 35. The hopper 35 is preferably frustro-conical shaped.

[Para 36] **FIG. 4** is a top view of perforated hopper 35 with radius holes 36a, 36b and 36c. Perforated hopper opening 37 is in the center of perforated hopper 35. Perforated hopper 35 may be fabricated with multiple hopper opening(s) 37 depending on the customer's application. Perforated hopper 35 is typically made with a slope of approximately 20 degrees.

[Para 37] **FIG. 5** is a side view of air disc 19 with perforated hopper 35 welded inside. Air compartment 57a is created between dished 20 and perforated hopper 35 so air may diffuse equally under the entire surface area of perforated hopper 35.

[Para 38] **FIG. 6** is a top view of air disc 19 with perforated hopper 35 welded inside. Hopper support ring 38 is welded to the under side of perforated hopper 35 to provide extra support when the storage vessel (not shown) is filled. Rows of holes 35a, 35b and 35c should account for approximately 20% to 50% of the area of perforated hopper 35. Any holes 35a, 35b and 35c more and perforated hopper 35 may become weakened and any less and the aeration method may become uneven and cause flow problems. Perforated hopper 35 may be made of multiple sections and then welded intodished head 20. Air disc 19 can also be made with multiple perorated hopper sections 35 (not shown), each one independent of the other for multiple discharge requirements.

[Para 39] **FIG. 7** is a side view of aeration liner 39 with outlet opening 41 and roped edge 40a assembly around its perimeter.

[Para 40] FIG. 8 is a top view of aeration liner 39. Top panel 43 and bottom panel 44 are cut so that when joined together they form a hopper-like cone with the same slope angle as the perforated hopper (not shown). Top panel 43 and bottom panel 44 may be cut from the same pattern and are generally made from a 4 ply, polyester woven fabric. All cut edges of aeration liner are heat-cut to melt the polyester so that it will not fray. Stitched seams 54a, 54b, 54c and 54d are used to joint and fasten top panel 43 to bottom panel 44. Scallop cut openings are made in perimeter flange 39f area so that bolts may remain between the silo and air disc. Perimeter holes 56a are cut in the center of aeration liner 39 around outlet opening 41. A sealant may be applied to area 55a and 55b between top panel 43 and bottom panel 44 to help prevent leaking. Sealant and / or gasketing material may be pre-applied to top and bottom areas of perimeter flange area 39f. Extra layers of flexible material such as fabric or rubber, as well as rigid materials such as steel, may be used in the perimeter flange 39f area to make up the difference and even out between a single layer of fabric and the double layer of fabric between seams 44a and 43a. Aireation liner 39 can also be made with multiple openings having separate inflation compartments when used for applications having multiple discharge requirements.

[Para 41] FIG. 9 is a detailed side view of air disc 19 attached to silo hopper 45. To change and / or install a new aeration liner 39, perimeter flange bolts 33xa - 33xx (33xr and 33xf shown) are loosened. Bolts 34xa - 34xd are placed in threaded flange holes 34a - 34d respectively (34xa is shown). Bolts 34xa to 34xd are used to help spread silo flange 47 and flange ring 21, especially is a sealant was used when installing the previous aeration liner. Scallop cut opening 42a - 42x enable aeration liner 39 to be removed without having to remove air disc 19 from silo hopper 45. Couplings 49 (and 49a, not shown) may be unfastened and removed from joints between conveyor tube 48a and entry tube 51 of rotary valve assembly 50 and between exit tube 52 and conveyor tube 48b. Roped edge 40a may be used around perimeter flange 39f area for extra support and grip to hold aeration liner in place. Perforated hopper 35 is used to support aeration liner 39. Outlet flange 27 and stack-up flange 53 may be slotted to provide more rotation and position

points when aligning conveyor tubes 48a and 48b with entry tube 51 and exit tube 52. Outlet flange ring bolts 22xa – 22xk (22xa and 22xb shown) are used to secure outlet flange ring 22 around outlet opening 25 of dished head 20.

[Para 42] FIG. 10 is a side view of left half of aeration liner 39a and right half of aeration liner 39b butted together at joint 39j. Webbing strip 39w, which can be made of polyester or nylon webbing that is approximately 3 inches wide can be sewn to left half of aeration liner 39a with stitching 39s and right half of aeration liner 39b with stitching 39t. By using webbing strip 39w that is relatively thin, approximately 1/32" to 1/8" thick, to join left half of aeration liner 39a to right half of aeration liner 39b, aeration liner 39 will fit snuggly and evenly between the flange ring 21 (not shown) of air disc 20 (not shown) and flange ring 47 (not shown) of silo 45 (not shown).

[Para 43] FIG. 11 is a top view of aireation liner 39 that would be used in a typical 6' diameter air disc having a slope angle of approximately 15°. Seam edge 39ae of left half of aeration liner 39a is butted against seam edge 39be of right half of aeration liner 39b with webbing strips 39wa and 39wb sewn over seam edges 39wa and 39 to form a single aireation liner 39. Aireation Liner 39 can be made in one piece construction for smaller air discs (4 ply polyester belting can be purchased in 48" widths) or in multiple sections for larger air discs and or for air discs having a steeper slope angle, requiring more belting fabric. The preferred method of installing aireation liner 39 to air disc 20 (not shown) is to make the diameter of aireation liner 39 larger than the diameter of the air disc flange 21(not shown) so that the perimeter 39p extends a few inches outward and can be trimmed off at the time of installing air disc 20 to silo 45. Perimeter holes as shown by hole 42n and spout holes as shown by 56a can actually punched in place by using a hammer and drift pin. The installer simply feels for the holes in the air disc flanges and hammers the drift pin through the belting fabric of the aireation liner. A bead of caulk may be applied to the air disc surfaces under the aireation liner to provide an airtight and leak proof connection.

[Para 44] FIG. 12 is a side view of air disc 20 having discharge spout 27m with bottom flange ring 27. To make the installation process easier to perform when connecting discharge spout 27m to rotary valve assembly 50, slip ring 27sr is located above flange ring 27. Slip ring 27sr is equipped with holes so that slip ring 27sr can be rotated to align with holes of stack-up flange 53 of rotary valve assembly 50. Gasket or caulk material (not shown) may be placed between slip ring 27sr, flange ring 27 and stack-up flange 53 to form tight and leak-proof connection. Bolts 27ba and 27bb can be used to connect and hold slip ring 27sr and stack-up flange 53 together.

[Para 45] While there have been described what are at present considered to be the preferred embodiments of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed to cover all such changes and modifications as fall within the true spirit and scope of the invention.